(54) **PROPYLENE POLYMER COMPOSITION AND THERMOFORMED OBJECT**

PROPYLENPOLYMER-ZUSAMMENSETZUNG UND UNTER WÄRME GEFORMTER
GEGENSTAND

COMPOSITION DE POLYMERE DE PROPYLENE ET OBJET THERMOFORME

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## Description

## TECHNICAL FIELD

5    **[0001]**   The present invention relates to propylene polymer compositions and heat molded products. More particularly, the invention relates to propylene polymer compositions from which heat molded products having good balance between rigidity and impact resistance are obtainable and relates to heat molded products obtainable from the compositions.

10   ## BACKGROUND ART

**[0002]**   Because of its excellent rigidity, heat resistance and impact resistance, polypropylene is molded by various molding processes and used in many fields. The properties required for the polypropylene differ from each other according to the molding process or the use of the polypropylene. For example, when the polypropylene is used as a
15   material of sewage pipe, potable water pipe or gas pipe, excellent pipe fatigue properties, mechanical strength and moldability are required for the polypropylene. Recently, there has been a growing demand for improvement in rigidity for the purpose of increasing economical efficiency by for example thinning the pipe wall, and there has been a growing demand for improvement in moldability for the purpose of decreasing electric power consumption. When the polypropylene is used as a material of films, impact resistance is required and also transparency is occasionally required for
20   the polypropylene.

**[0003]**   The present inventors have studied propylene polymer compositions capable of producing heat molded products, particularly pipes and films, having excellent mechanical strength, and as a result they have found that heat molded products having excellent mechanical strength can be obtained from a composition comprising a propylene polymer of lower density which has a specific melt flow rate and a specific temperature at the maximum peak position of an endothermic curve measured by a differential scanning calorimeter and a propylene polymer of higher density
25   which has a specific melt flow rate and a specific temperature at the maximum peak position of an endothermic curve measured by a differential scanning calorimeter and that pipes and films obtained from the composition particularly have excellent properties. Based on the finding, the present invention has been accomplished.

30   ## DISCLOSURE OF THE INVENTION

**[0004]**   The propylene polymer composition according to the present invention is a composition comprising:

(A) a propylene polymer in an amount of 10 to 90 % by weight, said polymer having the following properties:
35

(1) the melt flow rate, as measured at 230 °C under a load of 2.16 kg, is in the range of 0.001 to 8 g/10 min,
(2) the temperature at the maximum peak position of an endothermic curve of said polymer measured by a differential scanning calorimeter (DSC) is in the range of 95 to 145 °C,
(3) the density is in the range of 885 to 905 kg/m³, and
40   (4) the content of constituent units derived from an α-olefin of 4 to 20 carbon atoms is in the range of 1.5 to 11 % by mol; and

(B) a propylene polymer in an amount of 90 to 10 % by weight, said polymer having the following properties:

45   (1) the melt flow rate, as measured at 230 °C under a load of 2.16 kg, is in the range of 0.1 to 600 g/10 min,
(2) the temperature at the maximum peak position of an endothermic curve of said polymer measured by a differential scanning calorimeter is in the range of 145 to 170 °C,
(3) the density is in the range of 905 to 916 kg/m³, and
(4) the content of constituent units derived from an α-olefin of 4 to 20 carbon atoms is in the range of 0 to 2
50   % by mol;

wherein (1) the melt flow rate ($MFR_A$ (g/10 min)) of the propylene polymer (A) and the melt flow rate ($MFR_B$ (g/10 min)) of the propylene polymer (B) satisfy the following relation

55
$$0.1 \leq \log(MFR_B/MFR_A) \leq 6.1,$$

and

(2) the density ($d_A$ (kg/m³)) of the propylene polymer (A) and the density ($d_B$ (kg/m³)) of the propylene polymer (B) satisfy the following relation

$$2 \leq d_B\text{-}d_A \leq 31.$$

[0005] A heat molded product obtained by heat molding the propylene polymer composition has excellent rigidity.

[0006] When a pipe is produced from the propylene polymer composition, the composition preferably has the following properties:

(1) the melt flow rate, as measured at 230 °C under a load of 2.16 kg, is in the range of 0.005 to 2.0 g/10 min,
(2) the temperature at the maximum peak position of an endothermic curve of said composition measured by a differential scanning calorimeter is in the range of 128 to 157 °C,
(3) the density is in the range of 899 to 911 kg/m³, and
(4) the flexural modulus of a pressed sheet specimen prepared from said composition at 200 °C is in the range of 800 to 1,900 MPa.

[0007] If the propylene polymer composition is heat molded into a pipe, the pipe has excellent rigidity and creep resistance.

[0008] When a film is produced from the propylene polymer composition, the composition preferably has the following properties:

(1) the melt flow rate, as measured at 230 °C under a load of 2.16 kg, is in the range of 4 to 25 g/10 min,
(2) the temperature at the maximum peak position of an endothermic curve of said composition measured by a differential scanning calorimeter is in the range of 128 to 157 °C,
(3) the density is in the range of 899 to 911 kg/m³, and
(4) the flexural modulus of a pressed sheet specimen prepared from said composition at 200 °C is in the range of 800 to 1,900 MPa.

[0009] If the propylene polymer composition is heat molded into a film, the film has excellent rigidity, transparency and impact resistance.

[0010] In the present invention, the propylene polymer (A) and the propylene polymer (B) are preferably those prepared by the use of a metallocene catalyst.

## BEST MODE FOR CARRYING OUT THE INVENTION

[0011] The propylene polymer composition according to the invention and the heat molded products obtained from the composition are described in detail hereinafter.

[0012] The propylene polymer composition of the invention is a composition comprising the following propylene polymer (A) and the following propylene polymer (B).

[0013] The propylene polymer (A) for forming the propylene polymer composition satisfies the following requisites (1) to (4).

(1) The melt flow rate (MFR), as measured at 230 °C under a load of 2.16 kg, is in the range of usually 0.001 to 8 g/10 min, preferably 0.005 to 6 g/10 min.
(2) The temperature (Tm), as measured by a differential scanning calorimeter (DSC), is in the range of usually 95 to 145 °C, preferably 100 to 140 °C.
(3) The density is in the range of usually 885 to 905 kg/m³, preferably 887 to 903 kg/m³.
(4) The content of constituent units derived from an α-olefin of 4 to 20 carbon atoms is in the range of usually 1.5 to 11 % by mol, preferably 2 to 10 % by mol. Examples of the α-olefins of 4 to 20 carbon atoms include 1-butene, 1-pentene, 1-hexene, 4-methyl-1-pentene, 1-octene, 1-decene, 1-dodecene, 1-tetradecene, 1-hexadecene, 1-octadecene and 1-eicosene. As the α-olefin, an α-olefin of 4 to 10 carbon atoms is preferable.

[0014] The propylene polymer (B) for forming the propylene polymer composition satisfies the following requisites (1) to (4).

(1) The melt flow rate (MFR), as measured at 230 °C under a load of 2.16 kg, is in the range of usually 0.1 to 600 g/10 min, preferably 0.3 to 500 g/10 min.

(2) The temperature (Tm), as measured by a differential scanning calorimeter (DSC), is in the range of usually 145 to 170 °C, preferably 147 to 168 °C.

(3) The density is in the range of usually 905 to 916 kg/m$^3$, preferably 906 to 915 kg/m$^3$.

(4) The content of constituent units derived from an $\alpha$-olefin of 4 to 20 carbon atoms is in the range of usually 0 to 2 % by mol, preferably 0 to 1 % by mol. As the $\alpha$-olefin, an $\alpha$-olefin of 4 to 10 carbon atoms is preferable.

[0015] The propylene polymer (A) and the propylene polymer (B) can be prepared by various processes. For example, they can be prepared using either a titanium catalyst formed from a solid titanium catalyst component and an organometallic compound catalyst component, a high-activity titanium catalyst formed from these components and an electron donor, or a metallocene catalyst formed from a metallocene compound and aluminoxane or the like. In the present invention, the propylene polymer (A) and the propylene polymer (B) are preferably those prepared by the use of a metallocene compound, particularly preferably those prepared by the use of the following metallocene catalyst.

[0016] The metallocene catalyst preferably used for preparing the propylene polymer (A) and the propylene polymer (B) for use in the invention comprises a metallocene compound of a transition metal selected from Group 4 of the periodic table, and an organoaluminum oxy-compound and/or an ionizing ionic compound.

[0017] The metallocene compound of a transition metal selected from Group 4 of the periodic table, that is used for forming the metallocene catalyst, is specifically represented by the following formula (I).

$$M^1 L^1{}_x \qquad (I)$$

[0018] In the above formula, M$^1$ is a transition metal selected from Group 4 of the periodic table, specifically zirconium, titanium or hafnium. x is a valence of the transition metal M$^1$ and denotes the number of ligands L$^1$ coordinated to the transition metal.

[0019] L$^1$ is a ligand coordinated to the transition metal, and at least one ligand L$^1$ is a ligand having cyclopentadienyl skeleton, such as a cyclopentadienyl group, an indenyl group, a 4,5,6,7-tetrahydroindenyl group or a fluorenyl group. The ligand having cyclopentadienyl skeleton may have substituents such as alkyl groups, cycloalkyl groups, aryl groups (e.g., phenyl and naphthyl), trialkylsilyl groups and halogen atoms.

[0020] When the metallocene compound has two or more groups having cyclopentadienyl skeleton as the ligands L$^1$, two of them are desirably bonded through a bonding group such as an alkylene group, a substituted alkylene group, a silylene group or a substituted silylene group.

[0021] L$^1$ other than the ligand having cyclopentadienyl skeleton is, for example, a hydrocarbon group of 1 to 12 carbon atoms, an alkoxy group, an aryloxy group, a sulfonic acid-containing group (-SO$_3$R$^a$ wherein R$^a$ is an alkyl group, an alkyl group substituted with a halogen atom, an aryl group, an aryl group substituted with a halogen atom, or an aryl group substituted with an alkyl group), a halogen atom or a hydrogen atom.

[0022] Examples of the metallocene compounds having zirconium as M$^1$ and containing two ligands having cyclopentadienyl skeleton are given below.

Ethylene-bis (indenyl)dimethylzirconium,
Ethylene-bis(indenyl)zirconium dichloride,
Isopropylidene (cyclopentadienyl-fluorenyl)zirconium dichloride,
Diphenylsilylene-bis(indenyl)zirconium dichloride,
Methylphenylsilylene-bis(indenyl)zirconium dichloride,
rac-Ethylene-bis(2-methyl-1-indenyl)zirconium dichloride,
rac-Dimethylsilylene-bis(2-methyl-1-indenyl)zirconium dichloride,
rac-Dimethylsilylene-bis(4,7-dimethyl-1-indenyl)zirconium dichloride,
rac-Dimethylsilylene-bis(2,4,7-trimethyl-1-indenyl)zirconium dichloride,
rac-Dimethylsilylene-bis(2,4,6-trimethyl-1-indenyl)zirconium dichloride,
rac-Dimethylsilylene-bis(4-phenyl-1-indenyl)zirconium dichloride,
rac-Dimethylsilylene-bis(2-methyl-4-phenyl-1-indenyl)zirconium dichloride,
rac-Dimethylsilylene-bis(2-methyl-4-($\alpha$-naphthyl)-1-indenyl)zirconium dichloride,
rac-Dimethylsilylene-bis(2-methyl-4-($\beta$-naphthyl)-1-indenyl)zirconium dichloride, and
rac-Dimethylsilylene-bis(2-methyl-4-(1-anthryl)-1-indenyl)zirconium dichloride.

[0023] There can be also exemplified metallocene compounds wherein zirconium is replaced with titanium or hafnium in the above-mentioned compounds.

[0024] In the present invention, also employable as the metallocene compound is a transition metal compound rep-

resented by the following formula (II) :

$$L^2M^2X_2 \qquad\qquad\qquad (II)$$

wherein $M^2$ is a metal of Group 4 or lanthanum series of the periodic table,

$L^2$ is a derivative of a delocalized $\pi$-bond group and imparts a restraint geometric shape to the active site of the metal $M^2$, and

each X is the same or different and is a hydrogen atom, a halogen atom, or a hydrocarbon group, a silyl group or a germyl group having 20 or less carbon atoms, silicon atoms or germanium atoms.

[0025] Of the compounds represented by the formula (II), a transition metal compound represented by the following formula (III) is preferable.



(III)
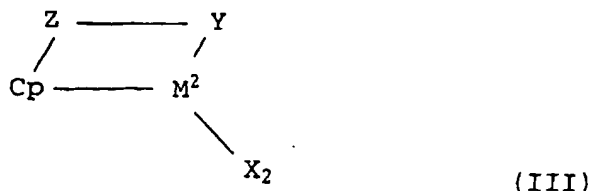
[0026] In the above formula, $M^2$ is titanium, zirconium or hafnium, and X is the same as above.

[0027] Cp is a substituted cyclopentadienyl group $\pi$-bonded to $M^2$ and having a substituent Z.

[0028] Z is oxygen, sulfur, boron or an element of Group 14 of the periodic table (e.g., silicon, germanium or tin) .

[0029] Y s a ligand containing nitrogen, phosphorus, oxygen or sulfur.

[0030] Z and Y may together form a condensed ring.

[0031] Examples of the compounds represented by the formula (III) include (dimethyl(t-butylamido) (tetramethyl-$\eta^5$-cyclopentadienyl)silane)titanium dichloride and ((t-butylamido)(tetramethyl-$\eta^5$-cyclopentadienyl)-1,2-ethanediyl)titanium dichloride.

[0032] The metallocene compounds mentioned above can be used singly or in combination of two or more kinds.

[0033] The metallocene compounds can be used by supporting them on particulate carriers.

[0034] Examples of the particulate carriers employable in the invention include inorganic carriers, such as $SiO_2$, $Al_2O_3$, $B_2O_3$, MgO, $ZrO_2$, CaO, $TiO_2$, ZnO, $SnO_2$, BaO and ThO; and organic carriers, such as polyethylene, polypropylene, poly-1-butene, poly-4-methyl-1-pentene and a styrene/divinylbenzene copolymer. These particulate carriers can be used singly or in combination of two or more kinds.

[0035] Next, the organoaluminum oxy-compound and the ionizing ionic compound used for forming the metallocene catalyst are described.

[0036] The organoaluminum oxy-compound may be conventional aluminoxane or such a benzene-insoluble organoaluminum oxy-compound as exemplified in Japanese Patent Laid-Open Publication No. 78687/1990.

[0037] The organoaluminum oxy-compound may contain a small amount of an organic compound component of a metal other than aluminum.

[0038] Examples of the ionizing ionic compounds include Lewis acids, ionic compounds, borane compounds and carborane compounds.

[0039] The Lewis acids are, for example, a compound represented by the formula $BR_3$ (R is a phenyl group which may have a substituent such as fluorine, methyl or trifluoromethyl, or a fluorine atom). Examples of such compounds include trifluoroboron, triphenylboron, tris(4-fluorophenyl)boron, tris(3,5-difluorophenyl)boron, tris(4-fluoromethylphenyl)boron, tris(pentafluorophenyl)boron, tris(p-tolyl)boron, tris(o-tolyl)boron and tris(3,5-dimethylphenyl)boron.

[0040] Examples of the ionic compounds include trialkyl-substituted ammonium salts, N,N,-dialkylanilinium salts, dialkylammonium salts and triarylphosphonium salts. Particular examples of the trialkyl-substituted ammonium salts include triethylammoniumtetra(phenyl)boron, tripropylammoniumtetra(phenyl)boron and tri(n-butyl)ammoniumtetra(phenyl)boron. Particular examples of the dialkylammonium salts include di(1-propyl)ammoniumtetra(pentafluorophenyl)boron and dicyclohexylammoniumtetra(phenyl)boron. Further, triphenylcarbeniumtetrakis(pentafluorophenyl)borate, N,N-dimethylaniliniumtetrakis(pentafluorophenyl)borate and ferroceniumtetra(pentafluorophenyl)borate are also

available as the ionic compounds.

[0041] Examples of the borane compounds include decaborane(14), bis[tri(n-butyl)ammonium]nonaborate, bis[tri(n-butyl)ammonium]decaborate, and salts of metallic borane anions such as bis[tri(n-butyl)ammonium]bis(dodecahydri-dododecaborate)-nickelate(III).

[0042] Examples of the carborane compounds include 4-carbanonaborane(14), 1,3-dicarbanonaborane(13), and salts of metallic carborane anions such as bis[tri(n-butyl)ammonium]bis(undecahydrido-7-carbaundecaborate)nickelate(IV).

[0043] The ionizing ionic compounds mentioned above can be used singly or in combination of two or more kinds.

[0044] The organoaluminum oxy-compounds or the ionizing ionic compounds can be used by supporting them on the aforesaid particulate carriers.

[0045] In the preparation of the catalyst, the following organoaluminum compound may be used together with the organoaluminum oxy-compound or the ionizing ionic compound.

[0046] As the organoaluminum compound, a compound having at least one Al-carbon bond in the molecule is employable. Such a compound is, for example, an organoaluminum compound represented by the following formula:

$$(R^1)_m Al(O(R^2))_n H_p X_q$$

wherein $R^1$ and $R^2$ may be the same or different and are each a hydrocarbon group of usually 1 to 15 carbon atoms, preferably 1 to 4 carbon atoms; X is a halogen atom; and m, n, p and q are numbers satisfying the conditions of $0 < m \leq 3$, $0 \leq n < 3$, $0 \leq p < 3$, $0 \leq q < 3$ and $m+n+p+q=3$.

[0047] The propylene polymer (A) can be prepared by copolymerizing propylene and a small amount of an α-olefin of 4 to 20 carbon atoms in the presence of the above-described metallocene catalyst, in accordance with a conventional process. The propylene polymer (B) can be prepared by homopolymerizing propylene or copolymerizing propylene and a small amount of an α-olefin of 4 to 20 carbon atoms in the presence of the above-described metallocene catalyst, in accordance with a conventional process.

[0048] If the propylene polymer (A) and the propylene polymer (B) are polymers prepared by the use of the metallocene compound, the content of the low-molecular weight component in the polymers is low. Therefore, the propylene polymer composition is almost free from burning in the heat molding process, and the resulting heat molded product hardly develops odor. Moreover, because the crystalline thickness becomes uniform, the heat molded product is excellent in impact resistance such as film impact and in creep resistance.

[0049] The propylene polymer composition comprises the propylene polymer (A) in an amount of 10 to 90 % by weight, preferably 20 to 80 % by weight, and the propylene polymer (B) in an amount of 90 to 10 % by weight, preferably 80 to 20 % by weight, and in this propylene polymer composition,

(1) the melt flow rate ($MFR_A$ (g/10 min)) of the propylene polymer (A) and the melt flow rate ($MFR_B$ (g/10 min)) of the propylene polymer (B) satisfy the following relation

$$0.1 \leq \log(MFR_B/MFR_A) \leq 6.1,$$

Preferably

$$0.2 \leq \log(MFR_B/MFR_A) \leq 5.7;$$

and
(2) the density ($d_A$ (kg/m$^3$)) of the propylene polymer (A) and the density ($d_B$ (kg/m$^3$)) of the propylene polymer (B) satisfy the following relation

$$2 \leq d_B - d_A \leq 31,$$

preferably

$$4 \leq d_B - d_A \leq 28.$$

**[0050]** To the propylene polymer composition, additives, such as weathering stabilizers, heat stabilizers, antistatic agents, anti-slip agents, anti-blocking agents, anti-fogging agents, lubricants, pigments, dyes, nucleating agents, plasticizers, anti-aging agents, hydrochloric acid absorbents and antioxidants, may be optionally added so long as they are not detrimental to the objects of the invention.

**[0051]** The propylene polymer composition can be prepared by a conventionally known process. For example, the propylene polymer composition can be prepared by producing the propylene polymer (A) and the propylene polymer (B) in two or more stages under different reaction conditions using one polymerization reactor. Specifically, the propylene polymer composition can be prepared by a two-stage polymerization process wherein the propylene polymer (A) is produced in the first stage and the propylene polymer (B) is produced in the second stage, or the propylene polymer (B) is produced in the first stage and the propylene polymer (A) is produced in the second stage.

**[0052]** The propylene polymer composition may also be prepared by the use of plural polymerization reactors. In this case, the propylene polymer (A) is produced in one polymerization reactor and the propylene polymer (B) is then produced in another polymerization reactor in the presence of the propylene polymer (A), or the propylene polymer (B) is produced in one polymerization reactor and the propylene polymer (A) is then produced in another polymerization reactor in the presence of the propylene polymer (B).

**[0053]** The following processes are also available.

(1) The propylene polymer (A), the propylene polymer (B) and other components optionally used are mechanically blended by the use of, for example, an extruder or a kneader.

(2) The propylene polymer (A), the propylene polymer (B) and other components optionally used are dissolved in an appropriate good solvent (e.g., hydrocarbon solvents such as hexane, heptane, decane, cyclohexane, benzene, toluene and xylene), and then the solvent is removed from the resulting solution.

(3) The propylene polymer (A), the propylene polymer (B) and other components optionally used are each dissolved separately in an appropriate good solvent to prepare solutions, then the solutions are mixed, and the solvents are removed from the mixture.

(4) The above processes (1) to (3) are appropriately combined.

**[0054]** The propylene polymer composition of the invention is subjected to various heat molding processes, such as blow molding, vacuum-pressure forming, calendering, inflation molding, cast molding, extrusion molding, foam molding, stretched film molding and injection molding, whereby heat molded products are obtained.

**[0055]** The propylene polymer composition of the invention has excellent moldability.

**[0056]** When a pipe is produced from the propylene polymer composition, the composition preferably has the following properties:

(1) the melt flow rate, as measured at 230 °C under a load of 2.16 kg, is in the range of 0.005 to 2.0 g/10 min, preferably 0.01 to 1.5 g/10 min,

(2) the temperature at the maximum peak position of an endothermic curve of said composition measured by a differential scanning calorimeter is in the range of 128 to 157 °C, preferably 130 to 155 °C,

(3) the density is in the range of 899 to 911 kg/m$^3$, preferably 900 to 910 kg/m$^3$, and

(4) the flexural modulus of a pressed sheet specimen prepared from said composition at 200 °C is in the range of 800 to 1,900 MPa, preferably 900 to 1,800 MPa.

**[0057]** The propylene polymer composition having the above properties shows excellent moldability into pipe, and the obtained pipe has excellent rigidity and creep resistance.

**[0058]** The above-mentioned propylene polymer composition can be prepared by, for example, melt kneading 30 to 70 parts by weight of the propylene polymer (A) having MFR (measured at 230 °C under a load of 2.16 kg) of 0.05 to 0.1 g/10 min, Tm (measured by DSC) of 105 to 115 °C, a density of 885 to 895 kg/m$^2$ and a C$_{4-20}$ α-olefin constituent unit content of 2 to 8 % by mol and 70 to 30 parts by weight of the propylene polymer (B) having MFR (measured at 230 °C under a load of 2.16 kg) of 0.1 to 0.8 g/10 min, Tm (measured by DSC) of 150 to 160 °C, a density of 905 to 915 kg/m$^2$ and a C$_{4-20}$ α-olefin constituent unit content of 0 to 1.0 % by mol, by means of an extruder.

**[0059]** The propylene polymer composition can also be prepared by a two-stage polymerization process, wherein the first stage is carried out to produce the propylene polymer (A) having MFR (measured at 230 °C under a load of 2.16 kg) of 0.002 to 0.02 g/10 min, Tm (measured by DSC) of 105 to 140 °C, a density of 885 to 904 kg/m$^2$ and a C$_{4-20}$ α-olefin constituent unit content of 2 to 8 % by mol and the second stage is carried out to produce the propylene polymer (B) having MFR (measured at 230 °C under a load of 2.16 kg) of 10 to 120 g/10 min, Tm (measured by DSC) of 145 to 165 °C, a density of 906 to 920 kg/m$^2$ and a C$_{4-20}$ α-olefin constituent unit content of 0 to 1.5 % by mol in such a manner that the propylene polymer (A) amounts to 30 to 70 % by weight and the propylene polymer (B) amounts to 70 to 30 % by weight, respectively, in the resulting composition.

**[0060]** When a film is formed from the propylene polymer composition, the composition preferably has the following properties:

(1) the melt flow rate, as measured at 230 °C under a load of 2.16 kg, is in the range of 4 to 25 g/10 min, preferably 5 to 20 g/10 min,

(2) the temperature at the maximum peak position of an endothermic curve of said composition measured by a differential scanning calorimeter is in the range of 128 to 157 °C, preferably 130 to 155 °C,

(3) the density is in the range of 899 to 911 $kg/m^3$, preferably 900 to 910 $kg/m^3$, and

(4) the flexural modulus of a pressed sheet specimen prepared from said composition at 200 °C is in the range of 800 to 1,900 MPa, preferably 900 to 1,800 MPa.

**[0061]** The propylene polymer composition having the above properties shows excellent moldability into film, and the obtained film has excellent transparency and impact resistance.

**[0062]** The above-mentioned propylene polymer composition can be prepared by, for example, melt kneading 30 to 70 parts by weight of the propylene polymer (A) having MFR (measured at 230 °C under a load of 2.16 kg) of 4 to 7 g/10 min, Tm (measured by DSC) of 105 to 115 °C, a density of 888 to 895 $kg/m^2$ and a $C_{4-20}$ α-olefin constituent unit content of 2 to 8 % by mol and 30 to 70 parts by weight of the propylene polymer (B) having MFR (measured at 230 °C under a load of 2.16 kg) of 10 to 20 g/10 min, Tm (measured by DSC) of 150 to 160 °C, a density of 905 to 915 $kg/m^2$ and a $C_{4-20}$ α-olefin constituent unit content of 0 to 1.0 % by mol, by means of an extruder.

**[0063]** The propylene polymer composition can also be prepared by a two-stage polymerization process, wherein the first stage is carried out to produce the propylene polymer (A) having MFR (measured at 230 °C under a load of 2.16 kg) of 0.01 to 2.0 g/10 min, Tm (measured by DSC) of 105 to 140 °C, a density of 885 to 904 $kg/m^2$ and a $C_{4-20}$ α-olefin constituent unit content of 2 to 8 % by mol and the second stage is carried out to produce the propylene polymer (B) having MFR (measured at 230 °C under a load of 2.16 kg) of 100 to 550 g/10 min, Tm (measured by DSC) of 145 to 170 °C, a density of 906 to 920 $kg/m^2$ and a $C_{4-20}$ α-olefin constituent unit content of 0 to 1.0 % by mol in such a manner that the propylene polymer (A) amounts to 30 to 70 % by weight and the propylene polymer (B) amounts to 70 to 30 % by weight, respectively, in the resulting composition.

**[0064]** In order to produce a pipe from the propylene polymer composition, an ordinary extrusion molding process can be adopted. The pipe produced by the process has excellent creep resistance.

**[0065]** In order to produce a film from the propylene polymer composition, a conventionally known molding process, such as casting or melt extrusion, can be adopted. The film produced by the process has excellent transparency and impact resistance.

## EFFECT OF THE INVENTION

**[0066]** From the propylene polymer composition of the invention, heat molded products having excellent mechanical strength can be produced. Further, the propylene polymer composition has excellent moldability into pipe, and the obtained pipe has excellent rigidity and creep resistance. The film produced from the propylene polymer composition of the invention has excellent transparency and impact resistance.

## EXAMPLE

**[0067]** The present invention is further described with reference to the following examples.

**[0068]** Properties of the compositions and the molded products in the examples were measured in the following manner.

## Melt flow rate (MFR)

**[0069]** The melt flow rate was measured at 230 °C under a load of 2.16 kg in accordance with ASTM D1238-65T.

## Melting point (Tm)

**[0070]** Using a differential scanning calorimeter (DSC), a sample of 5 mg was completely melted at 200 °C, cooled at a rate of 10 °C/min and then heated at a rate of 10 °C/min to detect an endothermic peak, and the temperature at the position of the endothermic peak was taken as a melting point.

Density

[0071] A strand containing no bubbles, which was obtained by the MFR measurement, was cut to give a specimen having a length of about 1 cm, and the specimen was introduced into a density gradient tube to measure the density.

α-Olefin content

[0072] In a sample tube having a diameter of 10 mm, about 200 mg of a sample was homogeneously dissolved in 1 ml of hexachlorobutadiene, and a $^{13}$C-NMR spectrum of the solution was measured under the conditions of a measuring temperature of 120 °C, a measuring frequency of 25.05 MHz, a spectral width of 1,500 MHz, a pulse repetition time of 4.2 sec and a pulse width of 6 μsec to determine the α-olefin content.

Flexural modulus (FM)

[0073] A FM test specimen was punched out from a pressed sheet having a thickness of 2 mm produced at 230 °C and was subjected to a FM test under the conditions of a temperature of 23 °C, a span of 32 mm and a flexural rate of 5 mm/min in accordance with ASTM D790 to determine the flexural modulus.

Creep resistance

[0074] In accordance with JIS K6762, a pipe having a length of 50 cm after 48 hours or more since molding was provided with closures at the both ends and was immersed in a water bath at 80 °C. Then, nitrogen was blown into the pipe to make a hoop stress be 6 MPa and to maintain the internal pressure constant. The period of time at the end of which the pipe was broken was measured to evaluate the creep resistance.

Transparency (haze)

[0075] The transparency was measured in accordance with ASTM D1003.

Film impact

[0076] The film impact was measured by a pendulum film impact tester manufactured by Toyo Seiki Seisakusho.

Example 1

[0077] Two-stage polymerization was carried out in accordance with a conventional process using a metallocene catalyst. That is, a propylene/octene copolymer (A-1) having properties shown in Table 1 was prepared in the first stage and a propylene homopolymer (B-1) having properties shown in Table 2 was prepared in the second stage, to obtain a propylene polymer composition (C-1) having a (A-1)/(B-1) weight ratio of 47/53 and having properties shown in Table 3. To 100 parts by weight of the propylene polymer composition (C-1), 0.4 part by weight of 1,3,5-trimethyl-2,4,6-tris(3,5-di-t-butyl-4-hydroxyphenyl)benzylbenzene, 0.2 part by weight of tetrakis[methylene-3-(3,5-di-t-butyl-4-hydroxyphenyl)propionate]methane, 0.2 part by weight of n-octadecyl-3-(4'-hydroxy-3',5'-di-t-butylphenyl)propionate, 0.15 part by weight of 2,4-di-t-butylphenyl-3,5-di-t-butyl-4-hydroxybenzoate and 0.1 part by weight of calcium stearate were added. The resulting mixture was melt kneaded at 230 °C by a single-screw extruder to obtain pellets. The pellets were subjected to extrusion molding at 260 °C to produce a pipe having an outer diameter of 60 mm and an inner diameter of 5.5 mm. The propylene polymer composition (C-1) had excellent moldability into pipe. The creep resistance of the obtained pipe is set forth in Table 3.

Example 2

[0078] Two-stage polymerization was carried out in accordance with a conventional process using a metallocene catalyst. That is, a propylene/octene copolymer (A-2) having properties shown in Table 1 was prepared in the first stage and a propylene homopolymer (B-2) having properties shown in Table 2 was prepared in the second stage, to obtain a propylene polymer composition (C-2) having a (A-2)/(B-2) weight ratio of 47/53 and having properties shown in Table 3. Using the propylene polymer composition (C-2), a pipe was produced in the same manner as in Example 1. The propylene polymer composition (C-2) had excellent moldability into pipe. The creep resistance of the obtained pipe is set forth in Table 3.

Example 3

[0079] To 100 parts by weight of a propylene polymer composition (C-3) which had properties shown in Table 3 and which consisted of 69 % by weight of a propylene/octene copolymer (A-3) prepared by a conventional process using a metallocene catalyst and having properties shown in Table 1 and 31 % by weight of a propylene homopolymer (B-3) prepared by a conventional process using a metallocene catalyst and having properties shown in Table 2, 0.4 part by weight of 1,3,5-trimethyl-2,4,6-tris(3,5-di-t-butyl-4-hydroxyphenyl)benzylbenzene, 0.2 part by weight of tetrakis [methylene-3-(3,5-di-t-butyl-4-hydroxyphenyl)propionate]methane, 0.2 part by weight of n-octadecyl-3-(4'-hydroxy-3', 5'-di-t-butylphenyl)propionate, 0.15 part by weight of 2,4-di-t-butylphenyl-3,5-di-t-butyl-4-hydroxybenzoate and 0.1 part by weight of calcium stearate were added. The resulting mixture was melt kneaded at 230 °C by a single-screw extruder to obtain pellets. The pellets were subjected to extrusion molding at 260 °C to produce a pipe. The propylene polymer composition (C-3) had excellent moldability into pipe. The creep resistance of the obtained pipe is set forth in Table 3.

Example 4

[0080] Two-stage polymerization was carried out in accordance with a conventional process using a metallocene catalyst. That is, a propylene/octene copolymer (A-4) having properties shown in Table 1 was prepared in the first stage and a propylene homopolymer (B-4) having properties shown in Table 2 was prepared in the second stage, to obtain a propylene polymer composition (C-4) having a (A-4)/(B-4) weight ratio of 60/40 and having properties shown in Table 3. To 100 parts by weight of the propylene polymer composition (C-4), 0.06 part by weight of tetrakis[methylene-3-(3,5-di-t-butyl-4-hydroxyphenyl)propionate]methane, 0.06 part by weight of tris-mono/dinonylphenyl phosphite, 0.05 part by weight of calcium stearate, 0.1 part by weight of erucylamide and 0.15 part by weight of silica were added. The resulting mixture was melt kneaded at 230 °C by a single-screw extruder to obtain pellets. The pellets were subjected to cast film molding at 260 °C to produce a film having a thickness of 50 μm. The propylene polymer composition (C-4) had excellent moldability into film. The transparency and film impact strength of the obtained film and the flexural modulus of the pressed sheet are set forth in Table 3.

Example 5

[0081] To 100 parts by weight of a propylene polymer composition (C-5) which had properties shown in Table 3 and which consisted of 49 % by weight of a propylene/octene copolymer (A-5) prepared by a conventional process using a metallocene catalyst and having properties shown in Table 1 and 51 % by weight of a propylene homopolymer (B-5) prepared by a conventional process using a metallocene catalyst and having properties shown in Table 2, 0.06 part by weight of tetrakis[methylene-3-(3,5-di-t-butyl-4-hydroxyphenyl)propionate]methane, 0.06 part by weight of tris-mono/dinonylphenyl phosphite, 0.05 part by weight of calcium stearate, 0.1 part by weight of erucylamide and 0.15 part by weight of silica were added. The resulting mixture was melt kneaded at 230 °C by a twinscrew extruder to obtain pellets. The pellets were subjected to cast film molding at 260 °C to produce a film having a thickness of 50 μm. The propylene polymer composition (C-5) had excellent moldability into film. The transparency and film impact strength of the obtained film and the flexural modulus of the pressed sheet are set forth in Table 3.

Examples 6 - 9

[0082] Pellets of propylene polymer compositions were prepared in the same manner as in Example 5, except for using propylene polymer compositions each of which consisted of a propylene/octene copolymer prepared by a conventional process using a metallocene catalyst and having properties shown in Table 1 and a propylene homopolymer prepared by a conventional process using a metallocene catalyst and having properties shown in Table 2 and each of which had a component ratio and properties shown in Table 3. The pellets were subjected to cast film molding at 260 °C to produce films having a thickness of 50 μm. All of the propylene polymer compositions had excellent moldability into film. The transparency and film impact strength of the obtained films and the flexural modulus of the pressed sheets are set forth in Table 3.

Table 1

| | Propylene Polymer (A) | | | | |
|---|---|---|---|---|---|
| | A-1 | A-2 | A-3 | A-4 | A-5 |
| MFR (g/10 Min) | 0.01 | 0.02 | 0.01 | 1.0 | 0.8 |
| TM (°C) | 130 | 130 | 132 | 128 | 131 |
| Density (kg/m$^3$) | 900 | 900 | 900 | 898 | 900 |
| α-olefin content (mol %) | Octene 4.2 | Octene 2.6 | Octene 4.3 | Octene 4.5 | Octene 4.2 |

Table 1 (Continued)

| | Propylene Polymer (A) | | | |
|---|---|---|---|---|
| | A-6 | A-7 | A-8 | A-9 |
| MFR (g/10 Min) | 0.5 | 0.2 | 0.09 | 2.0 |
| TM (°C) | 127 | 128 | 130 | 127 |
| Density (kg/m$^3$) | 898 | 898 | 900 | 899 |
| α-olefin content (mol %) | Octene 5.0 | Octene 5.3 | Octene 4.3 | Octene 5.1 |

## Table 2

| | Propylene Polymer (B) | | | | |
|---|---|---|---|---|---|
| | B-1 | B-2 | B-3 | B-4 | B-5 |
| MFR (g/10 Min) | 10 | 20 | 50 | 100 | 150 |
| TM (°C) | 160 | 148 | 165 | 160 | 165 |
| Density (kg/m$^3$) | 912 | 906 | 914 | 912 | 914 |

## Table 2 (Continued)

| | Propylene Polymer (B) | | | |
|---|---|---|---|---|
| | B-6 | B-7 | B-8 | B-9 |
| MFR (g/10 Min) | 100 | 180 | 400 | 100 |
| TM (°C) | 160 | 165 | 160 | 160 |
| Density (kg/m$^3$) | 912 | 915 | 913 | 912 |

Table 3

| | Examples | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Propylene polymer composition | C-1 | C-2 | C-3 | C-4 | C-5 |
| A/B weight ratio | 47/53 | 47/53 | 69/31 | 60/40 | 49/51 |
| MFR (g/10 min) | 0.1 | 0.2 | 0.1 | 8.0 | 8.1 |
| Tm (°C) | 145 | 137 | 140 | 146 | 148 |
| Density $(kg/m^3)$ | 906 | 903 | 904 | 906 | 907 |
| $\log(MFR_B/MFR_A)$ | 3 | 3 | 3.7 | 2 | 2.3 |
| $d_A-d_B$ | 12 | 6 | 14 | 14 | 14 |
| Pressed sheet FM (MPa) | 1450 | 1150 | 1260 | 1450 | 1540 |
| Pipe Creep Resistance | ◎ | ◎ | ◎ | - | - |
| Film Haze (%) | - | - | - | 3.5 | 4.0 |
| Film imapct (kJ/m) | - | - | - | 25 | 27 |

- : not measured

Table 3 (Continued)

| | Examples | | | |
|---|---|---|---|---|
| | 6 | 7 | 8 | 9 |
| Propylene polymer composition | C-6 | C-7 | C-8 | C-9 |
| A/B weight ratio | 64/36 | 67/33 | 65/35 | 52/48 |
| MFR (g/10 min) | 6.8 | 7.2 | 5.5 | 8.5 |
| Tm (°C) | 140 | 141 | 142 | 147 |
| Density (kg/m³) | 903 | 904 | 905 | 906 |
| log(MFR$_B$/MFR$_A$) | 2.3 | 3.0 | 3.6 | 1.7 |
| d$_A$-d$_B$ | 14 | 17 | 13 | 13 |
| Pressed sheet FM (MPa) | 1200 | 1240 | 1380 | 1470 |
| Pipe Creep Resistance | - | - | - | - |
| Film Haze (%) | 3.2 | 4.5 | 5.2 | 4.3 |
| Film imapct (kJ/m) | 28 | 28 | 30 | 23 |

- : not measured

**Claims**

1. A propylene polymer composition comprising:

(A) a propylene polymer in an amount of 10 to 90 % by weight, said polymer having the following properties:

(1) the melt flow rate, as measured at 230 °C under a load of 2.16 kg, is in the range of 0.001 to 8 g/10 min,
(2) the temperature at the maximum peak position of an endothermic curve of said polymer measured by a differential scanning calorimeter is in the range of 95 to 145 °C,
(3) the density is in the range of 885 to 905 kg/m³, and
(4) the content of constituent units derived from an α-olefin of 4 to 20 carbon atoms is in the range of 1.5 to 11 % by mol; and

(B) a propylene polymer in an amount of 90 to 10 % by weight, said polymer having the following properties:

(1) the melt flow rate, as measured at 230 °C under a load of 2.16 kg, is in the range of 0.1 to 600 g/10 min,
(2) the temperature at the maximum peak position of an endothermic curve of said polymer measured by a differential scanning calorimeter is in the range of 145 to 170 °C,
(3) the density is in the range of 905 to 916 kg/m³, and
(4) the content of constituent units derived from an α-olefin of 4 to 20 carbon atoms is in the range of 0

to 2 % by mol;

wherein (1) the melt flow rate (MFR$_A$ (g/10 min)) of the propylene polymer (A) and the melt flow rate (MFR$_B$ (g/10 min)) of the propylene polymer (B) satisfy the following relation

$$0.1 \leq \log(\text{MFR}_B/\text{MFR}_A) \leq 6.1,$$

and

(2) the density (d$_A$ (kg/m$^3$)) of the propylene polymer (A) and the density (d$_B$ (kg/m$^3$)) of the propylene polymer (B) satisfy the following relation

$$2 \leq d_B\text{-}d_A \leq 31.$$

2. The propylene polymer composition as claimed in claim 1, which has the following properties:

(1) the melt flow rate, as measured at 230 °C under a load of 2.16 kg, is in the range of 0.005 to 2.0 g/10 min,
(2) the temperature at the maximum peak position of an endothermic curve of said composition measured by a differential scanning calorimeter is in the range of 128 to 157 °C,
(3) the density is in the range of 899 to 911 kg/m$^3$, and
(4) the flexural modulus of a pressed sheet specimen prepared from said composition at 200 °C is in the range of 800 to 1,900 MPa.

3. The propylene polymer composition as claimed in claim 1, which has the following properties:

(1) the melt flow rate, as measured at 230 °C under a load of 2.16 kg, is in the range of 4 to 25 g/10 min,
(2) the temperature at the maximum peak position of an endothermic curve of said composition measured by a differential scanning calorimeter is in the range of 128 to 157 °C,
(3) the density is in the range of 899 to 911 kg/m$^3$, and
(4) the flexural modulus of a pressed sheet specimen prepared from said composition at 200 °C is in the range of 800 to 1,900 MPa.

4. The propylene polymer composition as claimed in any one of claims 1 to 3, wherein the propylene polymer (A) and the propylene polymer (B) are prepared by the use of a metallocene catalyst.

5. A heat molded product obtained by heat molding the propylene polymer composition as claimed in claim 1.

6. A pipe obtained by heat molding the propylene polymer composition as claimed in claim 2.

7. A film obtained by heat molding the propylene polymer composition as claimed in claim 3.


**Patentansprüche**

1. Propylenpolymer-Zusammensetzung, die umfasst:

(A) ein Propylenpolymer in einer Menge von 10 bis 90 Gew.%, wobei dieses Polymer die folgenden Eigenschaften hat:

(1) die Schmelzflussrate, gemessen bei 230°C unter einer Last von 2,16 kg, ist im Bereich von 0,001 bis 8 g/10 min,

(2) die Temperatur bei der maximalen Peakposition einer endothermen Kurve des Polymers, die mit einem Differential-Kalorimeter gemessen wird, liegt im Bereich von 95 bis 145°C,

(3) die Dichte liegt im Bereich von 885 bis 905 kg/m$^3$ und

(4) der Gehalt an aus einem α-Olefin mit 4 bis 20 Kohlenstoffatomen abgeleiteten Baueinheiten liegt im Bereich von 1,5 bis 11 mol-%; und

(B) ein Propylenpolymer in einer Menge von 90 bis 10 Gew.%, wobei das Polymer die folgenden Eigenschaften hat:

(1) die Schmelzflussrate, gemessen bei 230°C unter einer Last von 2,16 kg, liegt im Bereich von 0,1 bis 600 g/10 min,

(2) die Temperatur der maximalen Peakposition einer endothermen Kurve des Polymers, die mit einem Differential-Kalorimeter gemessen wird, liegt im Bereich von 145 bis 170°C,

(3) die Dichte liegt im Bereich von 905 bis 916 kg/m$^3$ und

(4) der Gehalt an aus einem α-Olefin mit 4 bis 20 Kohlenstoffatomen abgeleiteten Baueinheiten liegt im Bereich von 0 bis 2 mol-%;

worin (1) die Schmelzflussrate [MFR$_A$ (g/10 min)] des Propylenpolymers (A) und die Schmelzflussrate [MFR$_B$ (g/10 min)] des Propylenpolymers (B) die folgende Beziehung erfüllen:

$$0,1 \leq \log(MFR_B/MFR_A) \leq 6,1$$

und
(2) die Dichte [d$_A$ (kg/m$^3$)] des Propylenpolymers (A) und die Dichte [d$_B$ (kg/m$^3$)] des Propylenpolymers (B) die folgende Beziehung erfüllen:

$$2 \leq d_B - d_A \leq 31.$$

2.  Propylenpolymer-Zusammensetzung gemäss Anspruch 1, welche die folgenden Eigenschaften hat:

(1) die Schmelzflussrate, gemessen bei 230°C unter einer Last von 2,16 kg, ist im Bereich von 0,005 bis 2,0 g/10 min,

(2) die Temperatur bei der maximalen Peakposition einer endothermen Kurve des Polymers, die mit einem Differential-Kalorimeter gemessen wird, liegt im Bereich von 128 bis 157°C,

(3) die Dichte liegt im Bereich von 899 bis 911 kg/m$^3$ und

(4) der Biegemodul einer Probe aus einer gepressten Platte, die aus der Zusammensetzung bei 200°C hergestellt wurde, liegt im Bereich von 800 bis 1.900 MPa.

3.  Propylenpolymer-Zusammensetzung gemäss Anspruch 1, welche die folgenden Eigenschaften aufweist:

(1) die Schmelzflussrate, gemessen bei 230°C unter einer Last von 2,16 kg, ist im Bereich von 4 bis 25 g/10 min,

(2) die Temperatur bei der maximalen Peakposition einer endothermen Kurve des Polymers, die mit einem Differential-Kalorimeter gemessen wird, liegt im Bereich von 128 bis 157°C,

(3) die Dichte liegt im Bereich von 899 bis 911 kg/m$^3$ und

(4) der Biegemodul einer Probe aus einer gepressten Platte, die aus der Zusammensetzung bei 200°C hergestellt wurde, liegt im Bereich von 800 bis 1.900 MPa.

4.  Propylenpolymer-Zusammensetzung gemäss einem der Ansprüche 1 bis 3, worin das Propylenpolymer (A) und das Propylenpolymer (B) mit Hilfe eines Metallocen-Katalysators hergestellt werden.

**5.** Wärmegeformtes Produkt, das durch Wärmeformen der Propylenpolymer-Zusammensetzung gemäss Anspruch 1 erhalten wird.

**6.** Rohr, das durch Wärmeformen der Propylenpolymer-Zusammensetzung gemäss Anspruch 2 erhalten wird.

**7.** Folie, die durch Wärmeformen der Propylenpolymer-Zusammensetzung gemäss Anspruch 3 erhalten wird.

**Revendications**

**1.** Composition de polymère de propylène comprenant :

(A) un polymère de propylène dans une quantité de 10 à 90% en poids, ledit polymère ayant les propriétés suivantes :

(1) le débit d'écoulement en masse fondue, comme mesuré à 230 °C sous une charge de 2,16 kg, est dans la gamme de 0,001 à 8 g/10 min,
(2) la température à la position de pic maximum sur une courbe endothermique dudit polymère mesurée avec un calorimètre différentiel est dans la gamme de 95 à 145 °C,
(3) la densité est dans la gamme de 885 à 905 kg/m³, et
(4) la teneur en unités constitutives dérivées d'une $\alpha$-oléfine de 4 à 20 atomes de carbone est dans la gamme de 1,5 à 11 % en mole ; et

(B) un polymère de propylène dans une quantité de 90 à 10% en poids, ledit polymère ayant les propriétés suivantes :

(1) le débit d'écoulement en masse fondue, comme mesuré à 230 °C sous une charge de 2,16 kg, est dans la gamme de 0,1 à 600 g/10 min,
(2) la température à la position de pic maximum sur une courbe endothermique dudit polymère mesurée avec un calorimètre différentiel est dans la gamme de 145 à 170 °C,
(3) la densité est dans la gamme de 905 à 916 kg/m³, et
(4) la teneur en unités constitutives dérivées d'une $\alpha$-oléfine de 4 à 20 atomes de carbone est dans la gamme de 0 à 2 % en mole ;

où

(1) le débit d'écoulement en masse fondue ($MFR_A$ (g/10 min)) du polymère de propylène (A) et le débit d'écoulement en masse fondue ($MFR_B$ (g/10 min)) du polymère de propylène (B) satisfont la relation suivante :

$$0,1 \leq \log (MFR_B/MFR_A) \leq 6,1$$

et
(2) la densité ($d_A$ (kg/m³)) du polymère de propylène (A) et la densité ($d_B$ (kg/m³)) du polymère de propylène (B) satisfont la relation suivante :

$$2 \leq d_B\text{-}d_A \leq 31$$

**2.** Composition de polymère de propylène comme revendiqué dans la revendication 1, qui a les propriétés suivantes :

(1) le débit d'écoulement en masse fondue, comme mesuré à 230 °C psous une charge de 2,16 kg, est dans la gamme de 0,005 à 2 g/10 min,
(2) la température à la position de pic maximum sur une courbe endothermique de ladite composition mesurée avec un calorimètre différentiel est dans la gamme de 128 à 157 °C,
(3) la densité est dans la gamme de 899 à 911 kg/m³, et
(4) le module de flexion d'un spécimen de feuille pressée préparée à partir de ladite composition à 200 °C est

dans la gamme de 800 à 1900 MPa.

3. Composition de polymère de propylène comme revendiqué dans la revendication 1, qui a les propriétés suivantes :

(1) le débit d'écoulement en masse fondue, comme mesuré à 230 °C sous une charge de 2,16 kg, est dans la gamme de 4 à 25 g/10 min,
(2) la température à la position de pic maximum sur une courbe endothermique de ladite composition mesurée avec un calorimètre différentiel est dans la gamme de 128 à 157 °C,
(3) la densité est dans la gamme de 899 à 911 kg/m$^3$, et
(4) le module de flexion d'un spécimen de feuille pressée préparée à partir de ladite composition à 200 °C est dans la gamme de 800 à 1900 MPa.

4. Composition de polymère de propylène comme revendiqué dans n'importe laquelle des revendications 1 à 3, où le polymère de propylène (A) et le polymère de propylène (B) sont préparés par l'utilisation d'un catalyseur de métallocène.

5. Produit moulé à la chaleur obtenu par moulage à chaud de la composition de polymère de propylène telle que revendiquée dans la revendication 1.

6. Tuyau obtenu par moulage à chaud de la composition de polymère de propylène telle que revendiquée dans la revendication 2.

7. Film obtenu par moulage à chaud de la composition de polymère de propylène telle que revendiquée dans la revendication 3.